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CONTROL DOOR LOCK SYSTEM VIA SMS

MOHD RAZIF BIN ABDUL KADIR

Submitted to the Faculty of Electrical Engineering
in partial fulfillment of the requirement for the degree of
Bachelor of Engineering
(Electrical - Control & Instrumentation)

Faculty of Electrical Engineering
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Dedicated, in thankful appreciation for
support, encouragement and understandings to
my beloved parents Abdul Kadir Bin Aula and Khadijah Binti Mohd Yunos,
my brother, Norazlan Bin Abdul Kadir,
Mohd Nazim Bin Abdul Kadir, Othman Bin Abdul Kadir,
and my sisters, Roziana Binti Abdul Kadir
Thanks for everything

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Thank you so much.

ABSTRACT

GSM or better known as Global System Mobile is one of the mobile communications wiring systems. GSM is a second generation digital cellular systems that use circuit switching technology. GSM is basically designed to standardize the mobile technology in Europe but has spread to the whole world. However, due to the development of GSM technology is widespread use as International Roaming, Mobile Internet, mobile fax, e-mails, Fax and Short Messaging System (SMS). SMS usage among the world community led project control door lock system via SMS is carried out. With the knowledge of GSM and also the concept of electronic review this project will uses for the community and also use in the industrial sector.

ABSTRAK

GSM atau lebih dikenali sebagai Global System Mobile adalah salah satu sistem kabel komunikasi telefon. GSM merupakan kombinasi antara sistem khidmat digital dan khidmat pesanan ringkas (SMS). GSM pada dasarnya direka bentuk berdasarkan piawaian teknologi telefon di Eropah tetapi telah merebak ke seluruh dunia. Namun begitu, perkembangan teknologi GSM telah digunakan secara meluas sebagai Pengembaraan, telefon berinternet, faks melalui telefon, email, faks dan SMS. Penggunaan SMS di kalangan masyarakat dunia dipimpin projek sistem kawalan pintu di samping menggunakan SMS sebagai media penghantaran. Berdasarkan pengetahuan tentang GSM dan juga konsep ulasan elektronik, maka projek ini akan digunakan untuk masyarakat dan juga digunakan untuk sektor industri.

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LIST OF ABBREVIATIONS

PC	-	Personel Computer
SMS	-	Short Messaging System
FKE	-	Fakulti Kejuruteraan Elektrik
GSM	-	Global System Mobile
IT	-	Information Technology
PWM	-	Pulse Width Modulation
LED	-	Light Emmiting Diode
TTL	-	Transistor-Transistor Logic
TLD	-	Therapeutic Target Database
CMOS	-	Complementary Metal Oxide Semiconductor
DTMF	-	Dual Tone Multi Frequency
IC	-	Intergrated Circuit
CPU	-	Central Processing Unit
HF	-	High Frequency
AC	-	Alternating Current
DC	-	Directing Current
IDE	-	Integrated Development Enviroment
ARM	-	Advance RSIC Machine
MIPS	-	Million Instruction per Second
E.M Lock	-	Electromagnetic Lock

LIST OF SYMBOLS

cm	-	centimeter
RPM	-	Revolutions Per Minute
mN.m	-	Newton Meter
MHz	-	Mega Hertz

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CHAPTER 1

INTRODUCTION

1.1 Background

The Global System for Mobile Communication (GSM) is the most popular standard for mobile phone in the world. GSM service is used by over 2 billion people across more than 212 countries and territories. Cell radius varies depending on antenna height, antenna gain and propagation condition from a couple of hundred meters to a several tens of kilometers. The growth in the internet industry is immense and along with this trend wireless communication has rapidly gained wide acceptance, especially the cellular system such as GSM . Mobile terminal will the major main machine interface and not PC's anymore. Mobile telephony, presently superseding wired telephony, has become one of the most convenient information exchange tools since the implementation of the GSM standard in the early 1990ies [1].

The Short Messages Services (SMS) in GSM allows amongst other the transmissions of short text messages to mobile phones. In cases of an emergency the

SMS can be used to warn a large number of individual. SMS also can be used to control the some system like a control the flood warning, control the water pumps and so on. To control the system using SMS, GSM module and GSM remote control will be used.

A GSM remote control is a wonderful device which helps users control devices remotely, no matter how far the distance they are from them. Anything from home devices such as alarms, heating, air conditioning and so on, to commercial security systems or IT equipment such as routers and server and the like can be remotely controlled.

In essence, a GSM remote control is one of the most useful things out there. It is able to be turned to any practical use. The unit sits on the mobile phone network and is assigned a regular mobile number accordingly. Calling this number or even send a text will engage the unit, thus giving control of the end device it is connected to.

The GSM remote control can be set up to only engage when received from authorized numbers (secure control) or from any number across the world (open access control). As such, any device can be controlled from anywhere. This opens up many possibilities of course.

1.2 Objective of Project

The objective of the project is to design a locking system which is control by a GSM (Global System Mobile) module. By doing that person in charge of locking the

door can unlock the door just by sending an SMS to GSM module. Generally, the design of this system can help a person/supervisor to secure a building.

1.3 Scope of Project

Control door lock system via SMS is able to automate the system using:

1. Utilize a Global System Mobile (GSM) module to sent or received SMS from user.
2. Uses a relay that is connected to electromagnetic lock to open and close door.
3. To uses a microcontroller Atmel ATmega32 to set a program and allow all operation a function accordingly.

1.4 Problem Statement.

Criminal invasion of the home or office is often attributed to the attitude of the negligence of the homeowner. Although a various security has been taken such as Finger Print Based Door Lock System and Access Door Lock System using Keyword digital door the problem of criminal still happened.

By using GSM Remote Control, the user can increase the security of the building or residence from anywhere or anytime by only sending a message to device.

CHAPTER 2

LITERATURE REVIEW

GSM remote control is a tool that many produced in each country. Like the United States, Japan, China, and Italy. But not all the product produced by each country is similar. Results of the study, there were many differences in each GSM remote control issued by the state. Differences can be seen in terms of the components used, operating in each circuit are used, the chosen design, and also applications for each product. But the concept of equality is the same. The concept is to control a system to send SMS and change the data that is sent to the desired output.

2.1 Company GSM

From the results of the study, there are several manufacturers that produce products GSM remote control. Referred to table 1 shows a list of companies. All of this

is the company known for its GSM remote control products. The study was conducted for all companies in the world.

Table 2.1 : Company Manufacturer GSM Remote Control

No	Company Name	Product	Address
1.	DPS-Promatic srl.	TCX-EZGATE-PRO TCX-EZGATE-STD	47122 Forlì, Italy
2.	CrispTech	GSM8000	P.O. Box 468 Archerfield Qld 4108, Australia
4.	ElettroTERM S.r.l.	EL35.005	Via Villapizzone, 10 20156 Milano (MI)
5.	MERSYS Ltd.	GSM_A	23 Aizkraukles Str. Riga LV-1006 Latvia
6.	Atmel .Inc	AVR-GSM	2325 Orchard Parkway San Jose, Ca 95131 United States.
7.	Witura corporation Sdn. Bhd.	WT-9001	56-3A, Jalan PJU1/3B SunwayMas Commercial Centre 47301 Petaling Jaya, Selangor, Malaysia.
8.	Probyte	GSM Relay 2008	Nirvankatu 31, 33820 Tampere, FINLAND

Referring to the table 1 , there are many companies that produce products GSM remote control. In this chapter, the discussion is directed only to the two companies, those companies Witura Corporation Sdn. Bhd and also companies Probyte. Comparison between company Witura Corporation Sdn. Bhd. and Probyte is appropriate because there are many differences between these two companies. This is because the operation of the circuit, which is used for both components of the product and the functions of each circuit, is different. The product from Witura Corporation Sdn. Bhd. have much in common with other products such as products from Atmel company incorporation, MERSYS Ltd. and also CrispTech Ltd. and not suitable for comparison.

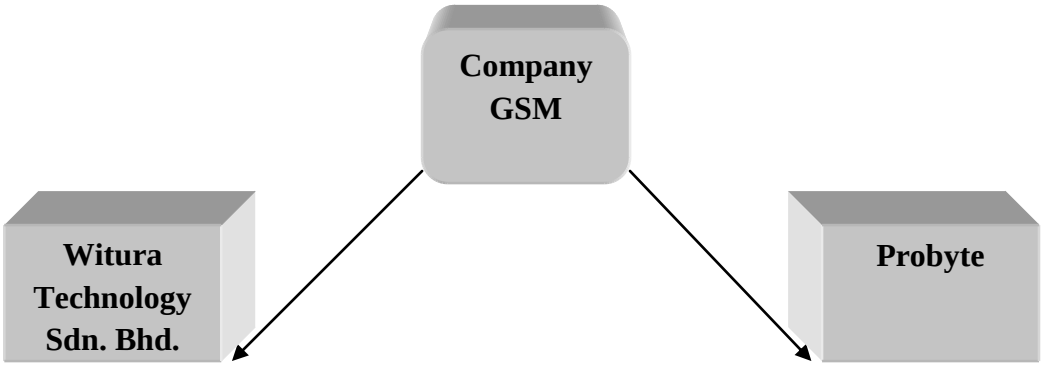

Figure 2.1 Comparison Between Two Companies GSM Remote Control

2.2 Description of each company.

For this section will discuss the company's products have been selected for the Witura Corporation Sdn. Bhd. and also Probyte. This discussion focuses on the operation, a block diagram and operation of the circuit for the both of these products. In addition, the application and use of the product will also be discussed in this section.

2.2.1 Witura Technology Sdn. Bhd.

Witura WT-9001 GSM remote control and GSM remote monitoring system allow user to use your mobile phone to monitor and control your business from any location. Its alarm facilities provide a flexible way to distribute critical alarm information to any number of mobile phone users.

WT-9001 GSM Controller will send alerts and status directly to your mobile phone and enable you to control simple applications at your remote site using text messages from your mobile phone. You can switch on your pumps or read the current dam level using your mobile phone while you are relaxing in a cafe bar or out on business. Almost anywhere, anytime.

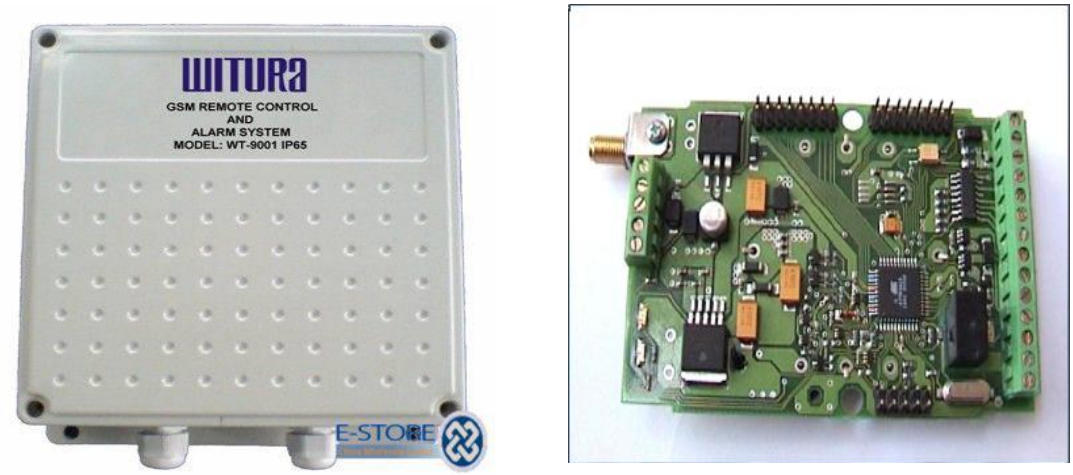

Figure 2.2 GSM Remote Control WT-9001 IP65

2.2.1.1 Description about Hardware

The WT 9001 GSM Controller module consists of the microprocessor, voltage regulator, inputs and outputs drivers, relay, built-in GSM modem with SIM-card holder, GSM antenna connector and connectors for external power supply and for input and output signals from external equipment connection. The module includes one opto-isolated and five non-isolated digital transistor inputs, one relay output and two MOSFET transistor outputs [4].

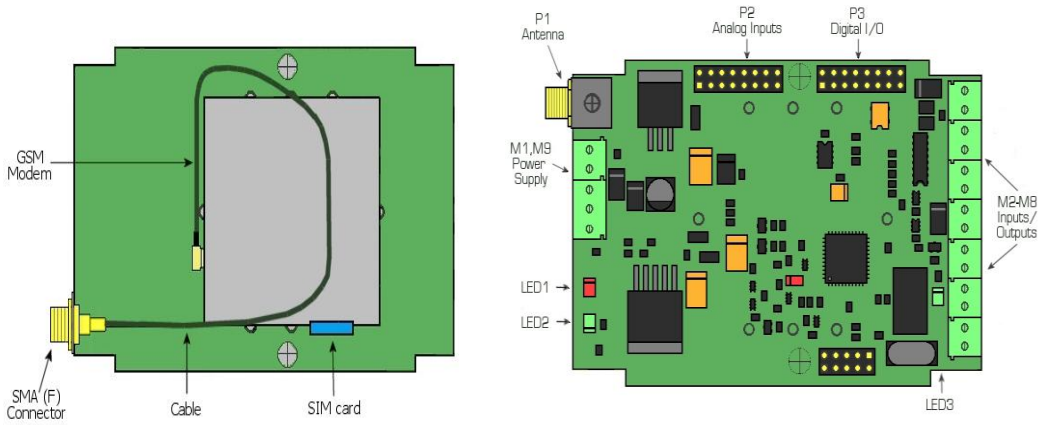

Figure 2.3 Internal Design WT-9001 IP65

Usually for users who want to use the product WT 9001, they need to understand the connection depends on the company's manual provided. there are some connections that need to be considered :

a) Screw terminal block for power supply connection (M1, M9)
b) Screw terminal blocks for Inputs and Outputs connection (M2...M8)
c) 2x8 pin header for analog inputs connection in analog version (P2)
d) 2x8 pin header used in special program version (P3)
e) SMA female connector for GSM antenna connection (P1)

There is also some indication to the user that should be taken out. This indicator is useful for consumers to know the status of the device to operate properly. There are two LED indicators on the device:

a) Red LED
b) Green LED

2.2.1.2 Installation WT-9001 IP65

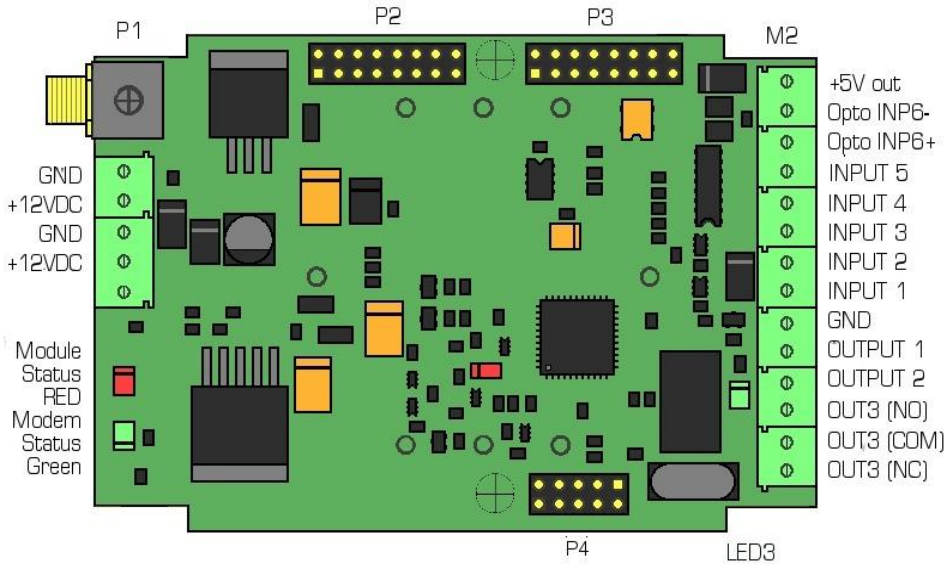

Figure 2.4 The installation diagram WT-9001 IP65

Before using the product WT-9001, users must comply with certain directives set by the user using this company. Among the matters to be observed are:

a) Preparing for a SIM card.

The SIM card must be serviced by a small 3V technology. Before using a SIM card for GSM SIM card remote control, users have to delete all SMS from the SIM, users also need to turn off the PIN code request to the instructions did not require a PIN code in operation. Users can prepare using a mobile phone SIM card and an external GSM modem.

b) External device connection.

For power supply connection, users need to connect the screw terminal block M1. Control output for connecting consumer devices to connect the screw terminal block on the M6 to M8. GSM antenna connection and the user must connect the antenna SMA in P1.

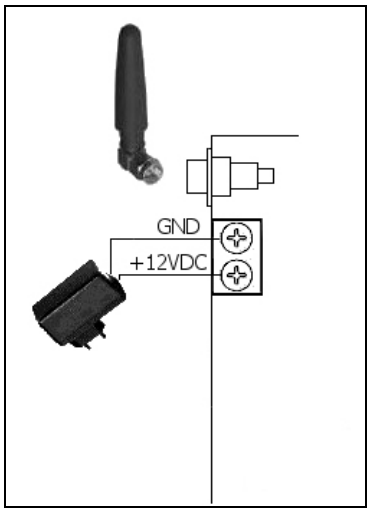

Figure 2.5 Antenna and Power Supply Connection.

c) Power Supply Connections

12VDC Power Supply must be connected with a stable screw terminal block. Use only stable 1A min (2A peak) 12VDC power supply. Power supply has put a negative voltage and over voltage protection.

d) Input and Output Connections

The table below represents Screw terminal blocks for inputs and Outputs connection:

Table 2.2 : Screw terminal blocks for Inputs and Outputs connection.

	Function	Description
1	+5V(output, 50mA max)	
2	INPUT 6-	Optoisolated Input "-"
3	INPUT 6+	Optoisolated Input "+"
4	INPUT5	Digital Input
5	INPUT 4	Digital Input
6	INPUT 3	Digital Input
7	INPUT 2	Digital Input
8	INPUT 1	Digital Input
9	GND	
10	OUTPUT 1	MOSFET Output
11	OUTPUT 2	MOSFET Output
12	OUTPUT 3	Relay Output NO
13	OUTPUT 3	Relay Output Common
14	OUTPUT 3	Relay Output NC

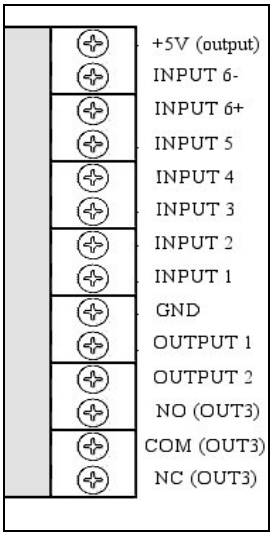

Figure 2.6 Schematic Diagram Screw Terminal Block

2.2.1.3 Operation of Internal Circuit.

a) Digital Transistor Inputs

The ULN2003A is monolithic high-voltage, high-current Darlington transistor arrays. Each consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA.

The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. The ULN2003A has a 2.7kΩ _series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

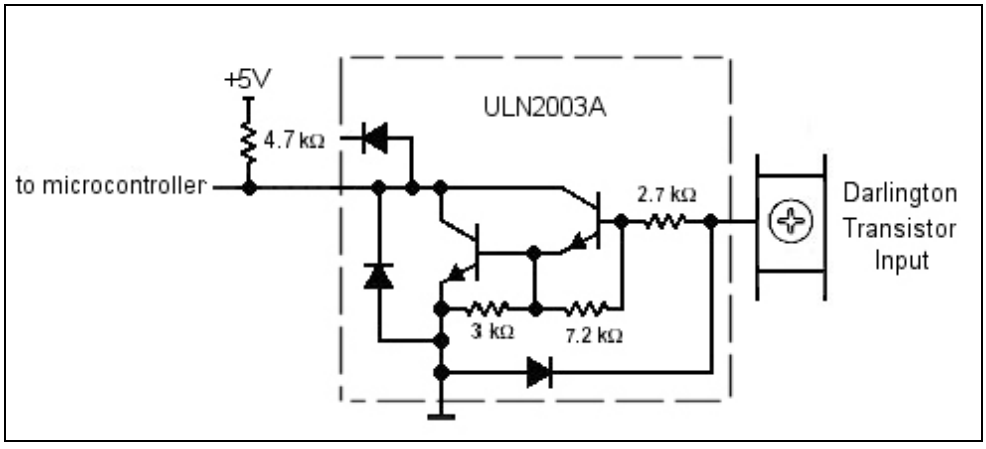

Figure 2.7 Schematic Diagram Digital Transistor Inputs

b) Opto-isolated Input.

The use of opto-isolated input is a switch operated. Operate to enable TLP 181, the input must be between the range of 3V to 30V (Screw terminal blocks M2, M3). If put in the opto-isolated voltage does not meet the prescribed range, the TLP181 is not to operate. These applications can be seen more clearly by further explanation. As an input to the Opto-Isolated reaches 3V TLP 181 will operate and cause the transistor to send data to the microcontroller. Enter the micro controller will receive a logic 1 (ON) if TLP181 operate and will receive a logic 0 (OFF) if the input opto-Isolated input is less than 3V or greater than 30V [3].

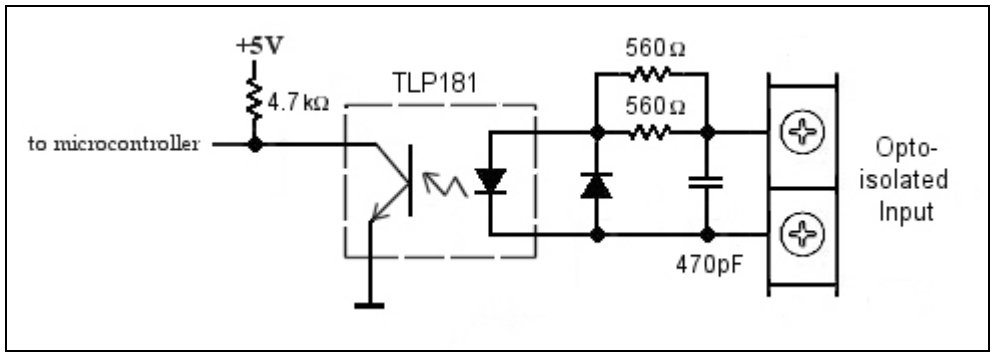

Figure 2.8 Schematic Diagram Opto-Isolated Inputs

c) MOSFET Outputs

MOSFETs are used both as discrete devices and as active elements in digital and analog monolithic integrated circuits. in this circuit, MOSFETs output should be connected to screw terminal blocks M6 and M7. MOSFET can

only operate at a range of not less than 20V. if the voltage applied to MOSFET operates more than 20V will cause the faulty component.

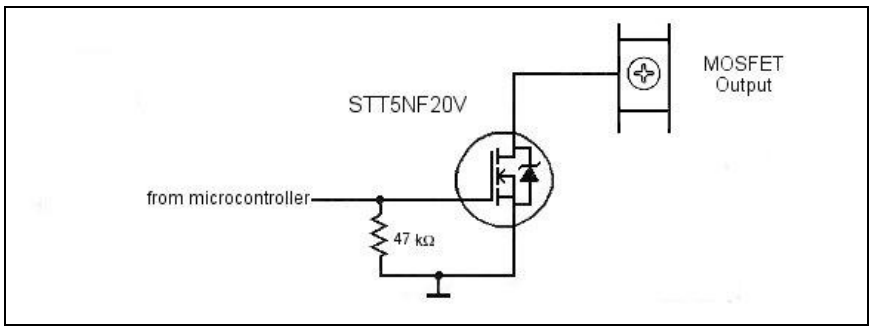

Figure 2.9 Schematic Diagram MOSFET Outputs.

d) Relay Outputs

Microcontroller will send data in logic 1 or 0. When the transistor receives the output logic 1 from the microcontroller, the transistor will operate in accordance with the output voltage of the microcontroller. When the voltage on the collector exceeds 0.7V, TSC112 relay will operate at 12V range and causes the switch command (COM) contact with Normally Open (NO). Screw terminals are connected to the relay blocks M7 and M8. These relays are only allowed to operate at voltages between 12V to 24V only

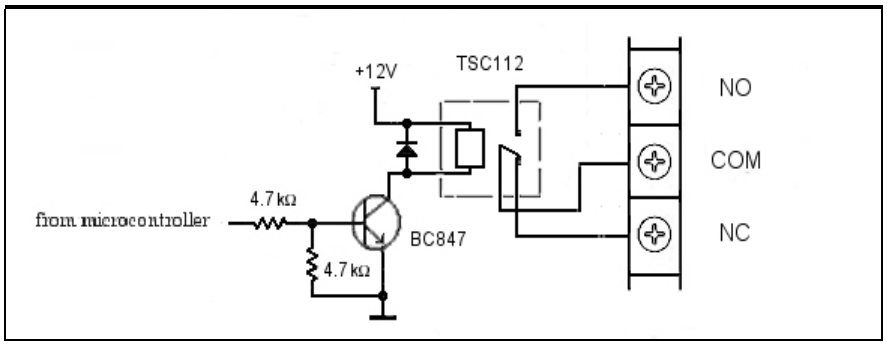

Figure 2.10 Schematic Diagram Relay Outputs.

2.2.1.4 Block Diagram of Operation WT-9001 IP65

From the discussion that has been done before, a summary of operations for the product WT-9001 is very easy. This circuit used is too complex and difficult for consumers to understand the detailed operation of the circuit. To facilitate understanding of the use of the product WT-9001, a block diagram is included below.

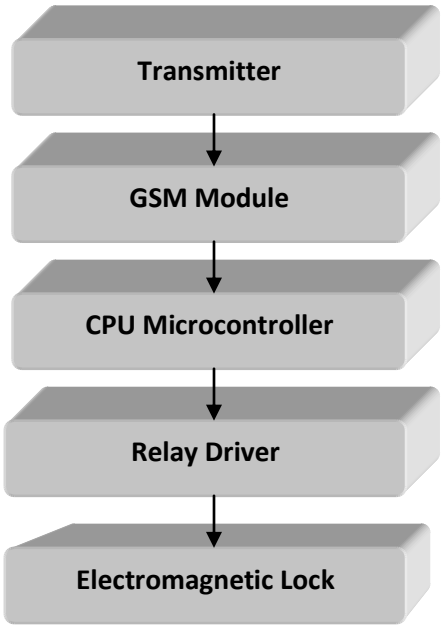

Figure 2.11 Block Diagram Process of Witura Corporation Sdn. Bhd.

Transmitter acts as a device to send the data entered. GSM module will receive data sent by the transmitter and to change the analog data to digital data by the DTMF decoder. The processed data will be sent to the CPU to the microcontroller and to determine the output relay. Output relay driver depends on the output of CPU microcontroller. Typically relay driver contain only IC which acts as a switch to the relay. Electromagnetic lock will work depends on the output of the relay.

2.2.1.5 Application of WT-9001 IP65

WT 9001 is a versatile SMS alert device suited for most monitoring needs. it is a device which able to sent a information or status of a system to multiple users. There are many applications in the 9001 WT human life. This is because the safety of consumer products is guaranteed when using this product. Applications that are often used by very many users. From this study showed that there were two conditions that are often a lot of applications used by consumers. Among these applications are:

a) Application at home automation:
   - Gate Access Control
   - Open Garage
   - Turn On Lights
   - Irrigation Control
   - Home security Monitoring
   - Turn On Kitchen Appliances
   - Turn On Air Conditioning
   - Turn On Heating System

b) Application at Industrial Automation.
   - Active Barrier Gate
   - Aquarium Monitoring
   - Machine Control
   - Fuel Water Tank Monitoring
   - Water Tank Monitoring And Pump Control
   - Fleet management System
   - Greenhouse Monitoring
   - Turn On Generator.

2.2.2 Probyte.

PROBYTE GSM-control is a real time and interactive GSM-control- and measuring device, which allows user remotely control all the electrical appliances by a standard home phone or by a GSM-phone using DTMF-tones. User can at same time hear remote end. GSM relay is interactive for each pushbutton. The device has optional four digits password, which prevents unauthorized persons to operate GSM control.

A new password can be changed remotely by a user. Adding commands to end of phone number you can operate whole sequence without thinking whole process. Separate commands from phone numbers by a special pause command.

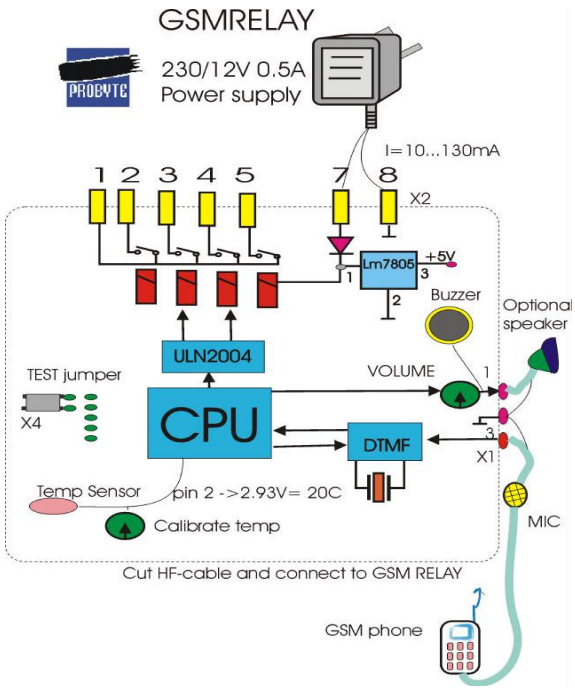

Figure 2.12 Simple Diagram GSM Relay 2009 Probyte.

2.2.2.1 Company Product

The GSM-Relay 2009 is based on previous versions of Probyte GSM-relays. They are used over ten years in tens of countries for tens of different purposes. A new program of the GSM-Relay 2009 can install on old versions hardware (models 2007-2008). The new program is made into bigger processor. There is no need for separate programs, control, thermostat and alarms are in the same CPU 2010 model. There are many new alarms and controls. The basic command is simple: the relay 1 on command is 011 and off the command 010. It can given locally, remotely or added to telephone number with p (=pause) character.

Figure 2.13 GSM Relay 2009 Probyte.

2.2.2.2 Specifications of GSM-Relay 2009

GSM-2010 relay is an interactive remote control to output 4 relay. In contrast to WT-9001 uses only 2 relay output only. GSM-Relay 2009 can operate at voltages of 12VDC 500 mA. Controls carried out by the user by adding the command to terminate

the telephone number or by pressing a button on a GSM phone. Usually automatic, a GSM modem can send DTMF-code using a separate PC or on a program that is embedded in the microcontroller. GSM-relay unit has a connection hand free (HF) to be connected to a Nokia phone with a 4 pin connector.

2.2.2.3 Block Diagram of Operation GSM-Relay 2009

From the discussion that has been done before, a summary of operations for the product WT-9001 is very easy. This circuit used is too complex and difficult for consumers to understand the detailed operation of the circuit. To facilitate understanding of the use of the product WT-9001, a block diagram is included below.

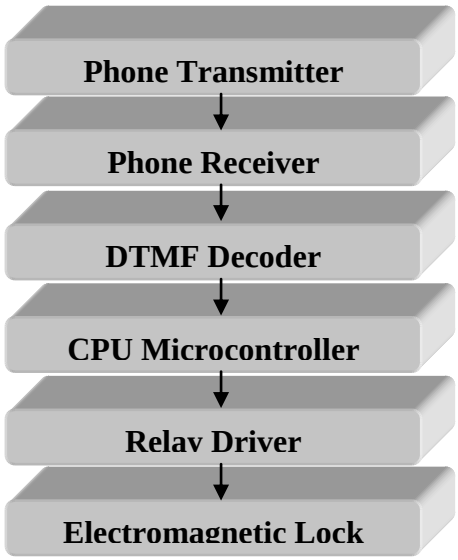

Figure 2.14 Block Diagram Operation of GSM-Relay 2009 Probyte.

2.2.2.4 Circuit Operation

To clearly understand the operation of the circuit in GSM-Relay, the circuit diagram attached at Figure. Refer to the Figure there are several very important part in the GSM-Relay process [2]. Between the processes included in this device are:

a) DTMF Decoder = Using IC MT8870B
b) CPU Microcontroller = Using PIC 16F872
c) Alarm Option
d) Power Supply = Using IC 7805
e) Relay Driver = Using ULN2004
f) Temperature Sensor = Using LM335z

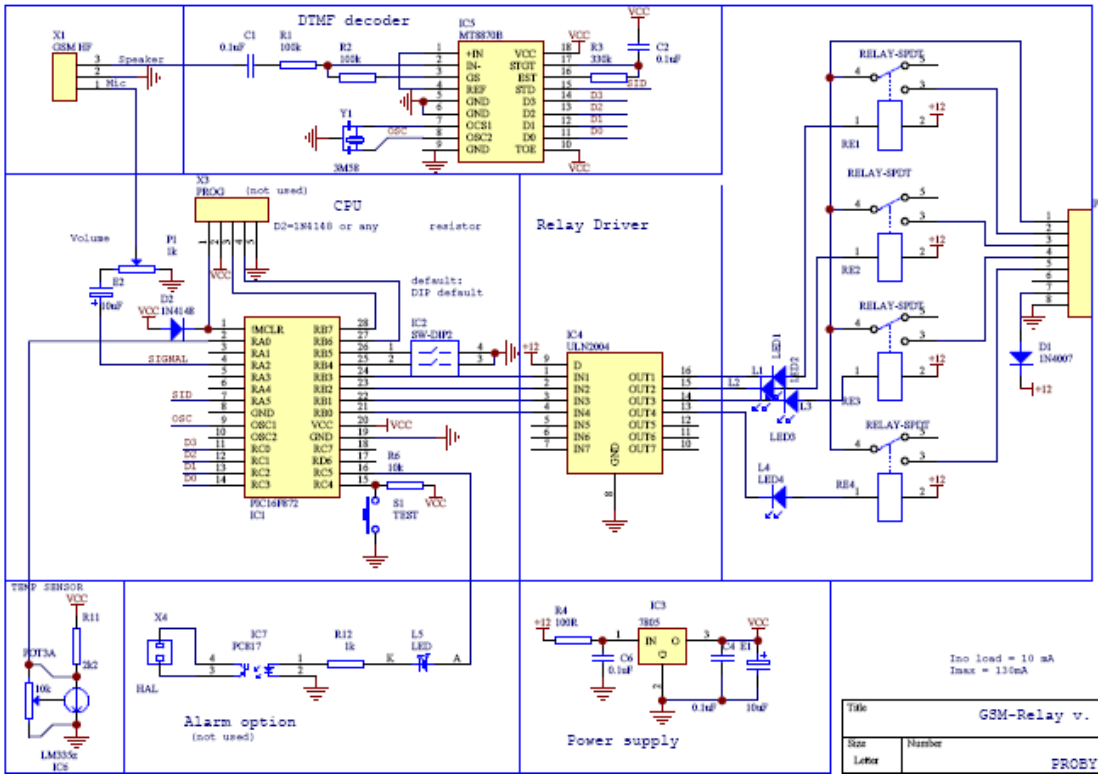

Figure 2.15 Circuit Diagram GSM-Relay 2009 Probyte

2.2.2.5 Application of GSM-Relay 2009

a) The remote controlled heating and remote controlled GSM-lock.
b) The heat control and door management of rented cottage for the owner
c) The remote control and alarm for grain drier for the farmers.
d) Pellet wood heater alarm
e) The remote control of car heating.
f) A door lock opens door for the service man even you are not at home.

CHAPTER 3

METHODOLOGY

In this section discussed how research is done in Chapter 2 can applied in this system to control door lock system via SMS. There are two important part to be taken into consideration to make this system will smooth operated. These part were be divided in the hardware development and the software development. The further explanation for the both of parts were be discussed in the below.

3.1 Hardware development.

Hardware development will be explain how to design concepts and circuits to be made to control this system. normally, some things need to be considered as a way to make the system more complex and also reduce the cost of making these systems. The further information will be described in the below.

3.1.1 Block Diagram Control Door Lock System Via SMS.

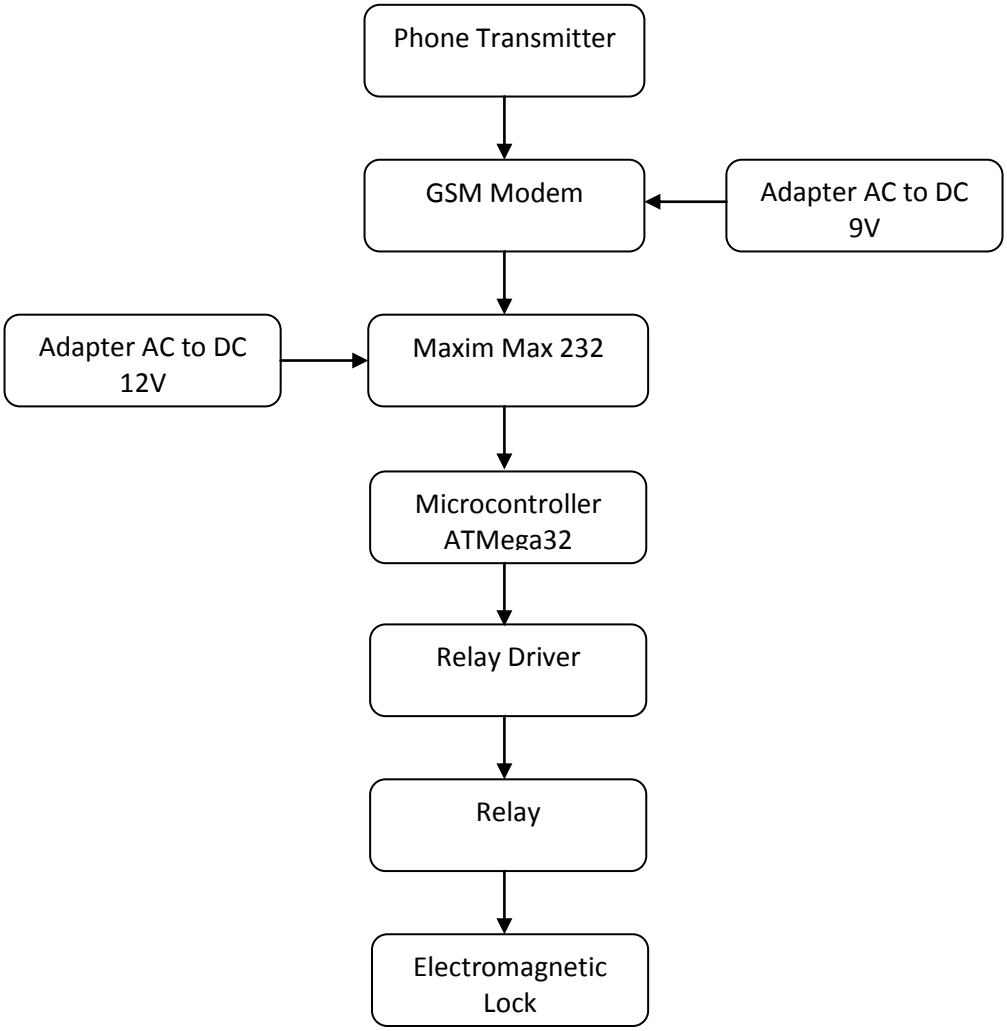

Figure 3.1 Block diagram GSM Control Door Lock System

3.1.2 Part of Hardware

There are several steps that should be taken in making any hardware in these systems. This system must be related to the block diagram of the system. Further information about the circuit and the equipment were be used will described in the below.

3.1.2.1 Adapter AC to DC

Adapter AC to DC converter is a powerful device can convert an analog current to a direct current. This adapter usually uses a transformer to convert the voltage from the wall outlet which the output voltage from the outlet is 240V analog current. This adapter used to produce DC, a rectifier is used to convert alternating voltage to a pulsating direct voltage, followed by a filter, comprising one more capacitors, resistors, and sometimes inductors, to filter out (smooth) most of the pulsation. A small remaining unwanted alternating voltage component at mains or twice mains power frequency is unavoidably superimposed on the direct output voltage. For purposes such as charging batteries the ripple is not a problem, and the simplest unregulated main powered DC power supply circuit consists of a transformer driving a single diode in series with a resistor.

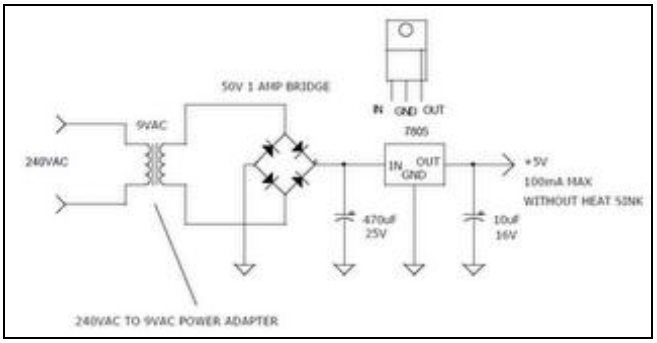

Figure 3.2 Basic Circuit for Adapter AC to DC Converter.

For this project, there are use two adapter converter. The input voltage for the both adapter is 240V analog current and the outlet voltage for the each one is 12V and 9V. The adapter 12V used for supply voltage to the circuit and the other adapter 9V is use for supply voltage to the GSM modem. The purpose used adapter 12V is to supply energy to electromagnetic lock and for the circuit controller. While the adapter 9V is to supplied energy to GSM Modem.

Figure 3.3 Adapter AC to DC converter 12V and 9V

3.1.2.2 GSM Modem

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. For the complete this project, GSM/GPRS Terminal Modem MLIS were chosen. The MLIS modem is a compact size and robust Tri-Band GSM/GPRS terminal designed for industrial use. It also has the TCP/IP stack in-built to support different internet services. Therefore, it can be deployed easily in plug and play M2M and many other applications.

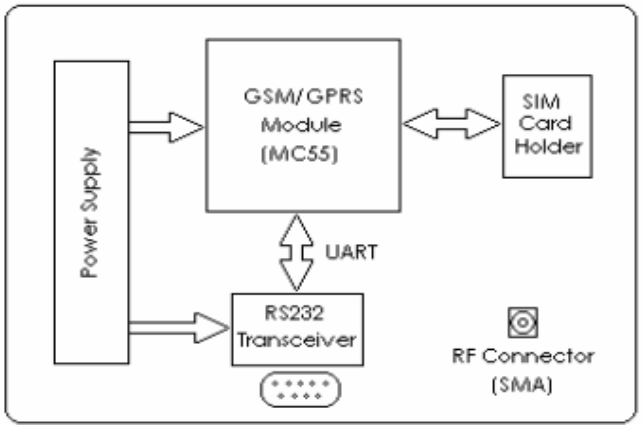

Figure 3.4 MLIS Modem Basic Terminal Block Diagram

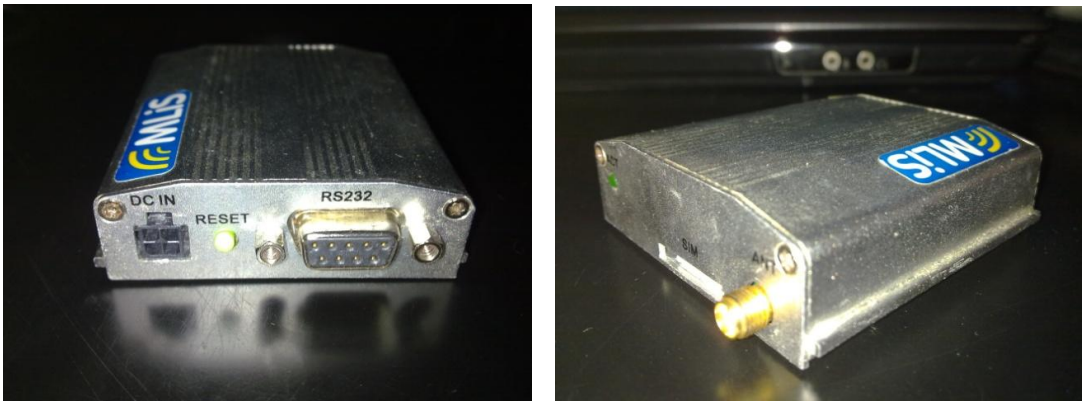

Figure 3.5 MLIS GSM Modem

3.1.2.3 Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. For this project, four voltage regulators were used to avoid each voltage regulator from continuously heat. Each voltage regulator has a serial number, which is 7812, 7809, 7806 and 7805. The input voltage of voltage regulator circuit is 12V direct current that supply from the adapter. This voltage regulator circuit was reducing the voltage from 12V to 5V [5].

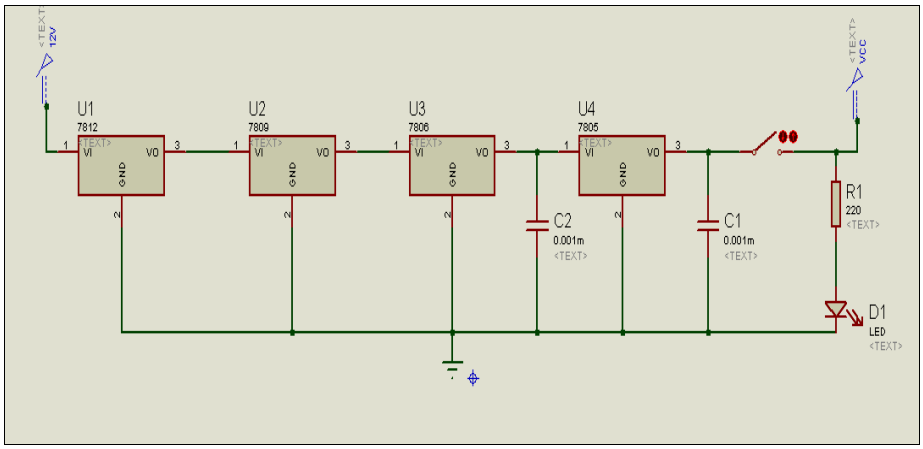

Figure 3.6 Circuit Diagram Voltage Regulator

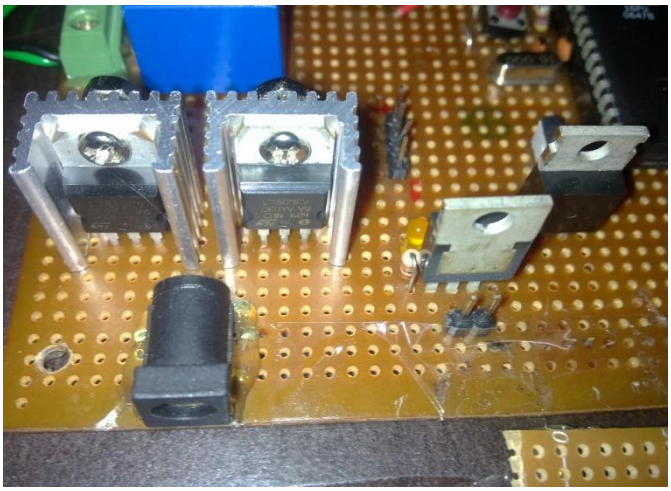

Figure 3.7 Voltage Regulator Circuit

3.1.2.4 Max 232 Serial Level Converter

Almost all digital devices which used require either Transistor-Transistor Logic (TTL) logic levels. Therefore the first step to connecting a device to the RS-232 port is to transform the RS-232 levels back into 0 and 5 Volts. When these voltages have already covered, this is done by RS-232 Level Converters. Two common RS-232 Level Converters are the 1488 RS-232 Driver and the 1489 RS-232 Receiver. Each package contains 4 inverters of the one type, either Drivers or Receivers. The driver requires two supply rails, +7.5 to +15v and -7.5 to -15v. As user could imagine this may pose a problem in many instances where only a single supply of +5V is present. However the advantages of these I.C's are they are cheap.

Another device is the MAX-232. It includes a Charge Pump, which generates +10V and -10V from a single 5v supply. This I.C. also includes two receivers and two transmitters in the same package. This is handy in many cases when user only want to use the Transmit and Receive data Lines. Don't need to use two chips, one for the receive line and one for transmit. However all this convenience comes at a price, but

compared with the price of designing a new power supply it is very cheap. There are also many variations of these devices. The large values of capacitors are not only bulky, but also expensive. Therefore other devices are available which use smaller capacitors and even some with inbuilt capacitors. However the MAX-232 is the most common.

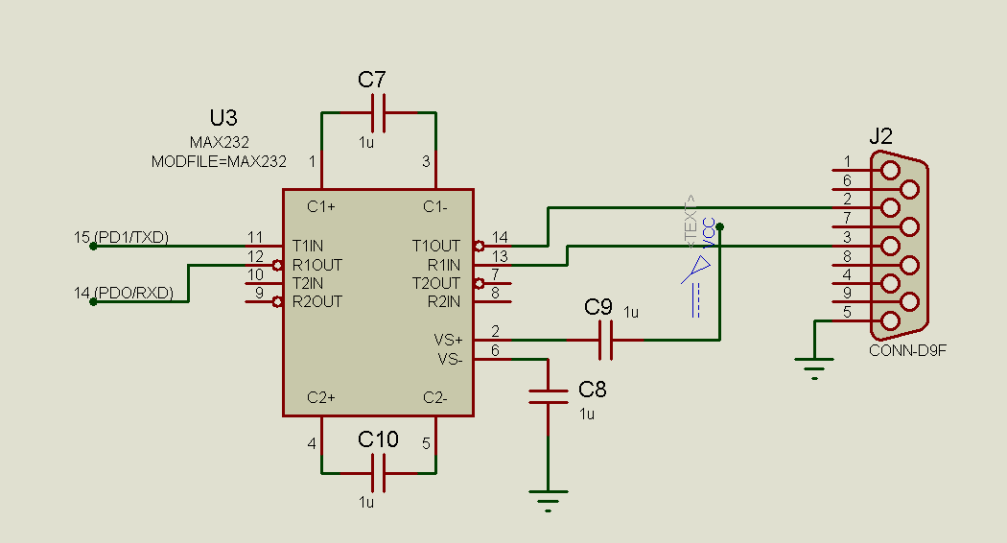

Figure 3.8 Circuit Diagram Max 232 Serial Level Converter

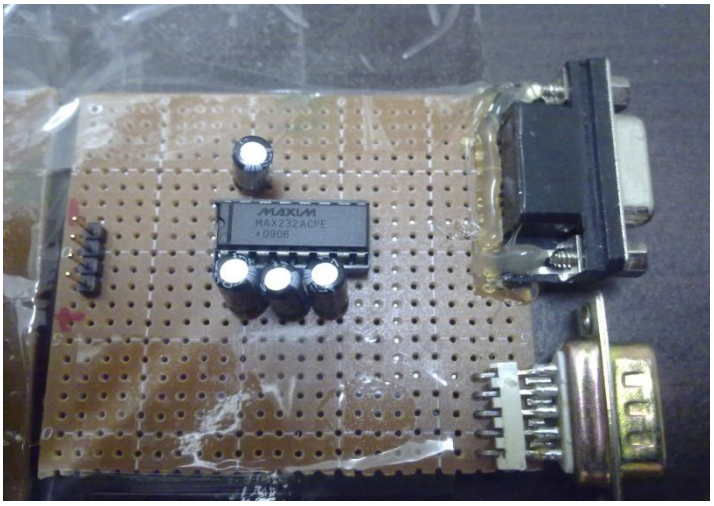

Figure 3.9 Max 232 Serial Level Converter

3.1.2.5 Microcontroller ATMega32

There are numerous choices for microcontrollers. In this project, microcontrollers ATMega32 series made by Atmel were chosen. The Atmel chips can be easily programmed. User can write code in the higher level C, instead of assembly language. The ATMega32 series have more Pulse-width modulation *(*PWM) channels, memory, Analog Digital Converters (ADC) channels, and Input-Output (I/O) lines than most other chips. The ATMega32 has 16 Million Instruction per second (MIPS) of processing power and 32 KB of flash. It has 4 PWM channels sufficient for us since user only needed one for the main motor controller.

Besides that, ATMega32 including in AVR family. AVR family has a GCC based IDE that is free for the whole range of their processors. From smallest to biggest, one code to rule them all. AVR is an 8-bit CPU and on the same clock it is 4 times faster than 8-bit PIC and 12 times faster than 8051. ARM is 32-bit, more powerful and much more power hungry. It will eat battery quickly while AVR will run for weeks or months. They are not in the same range, and not used for the same tasks. It would be like comparing 4GHz quad core biennium PC to small ARM that runs your mobile phone [6].

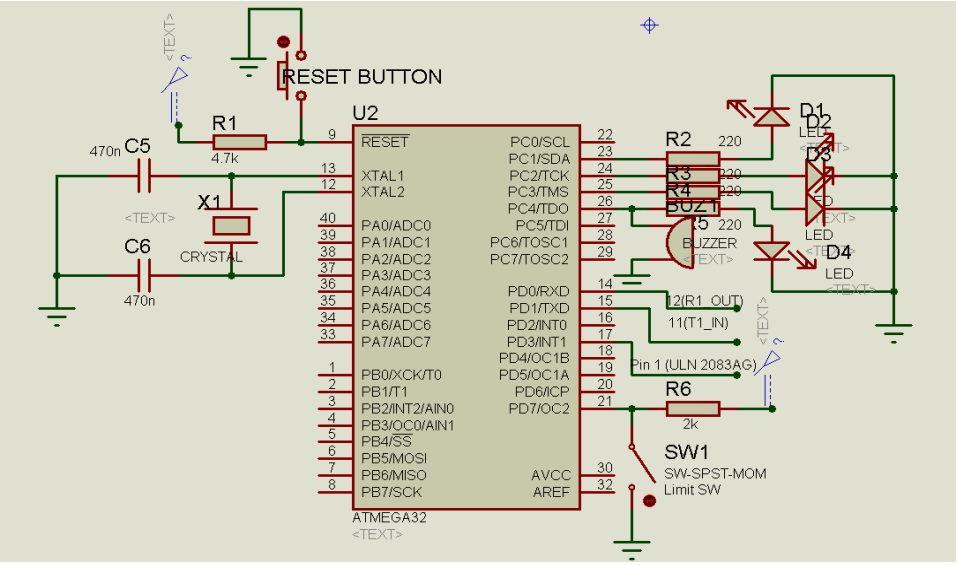

Figure 3.10 Circuit Diagram Microcontroller ATMega32

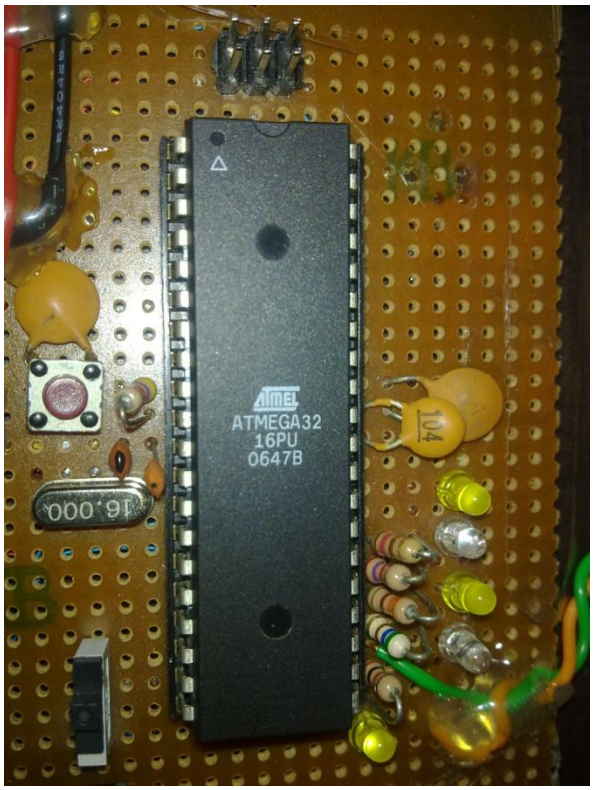

Figure 3.11 Microcontroller ATMega32

3.1.2.6 Relay Driver and Electromagnetic Lock

Relay Driver ULN2803AG was used to control the output of electromagnetic lock. The ULN2803AG is a small integrated circuit that contains 8 transistor driver channels. Each channel has an input to a resistor connected to the base of a transistor and a 1 amp open collector output capable of handling up to about 30volts (if my memory is correct). Each of the collectors has a reverse biased diode connected to a common Vcc pin that provides inductive spike protection.

Typical uses are for micro-processor interfaces to relays, lamps, solenoids and small motors. A ULN2803AG with a set of relays is a simple and effective way of switching mains voltages for example. They are used less commonly today but were once an almost universal means of interfacing processors to power devices.

While an electromagnetic lock is a locking device that locking door depending on the output of relay driver. This consists of an electromagnet and armature plate. By attaching the electromagnet to the door frame and the armature plate to the door, a current passing through the electromagnet attracts the armature plate holding the door shut. Unlike an electric strike a magnetic lock has no interconnecting parts and is therefore not suitable for high security applications because it is possible to bypass the lock by disrupting the power supply. Nevertheless, the strength of today's magnetic locks compares well with that of conventional door locks and they cost less than conventional light bulbs to operate. Power supplies incorporating a trickle-charged lead-acid battery pack can be used to retain security for short-term power outages [7].

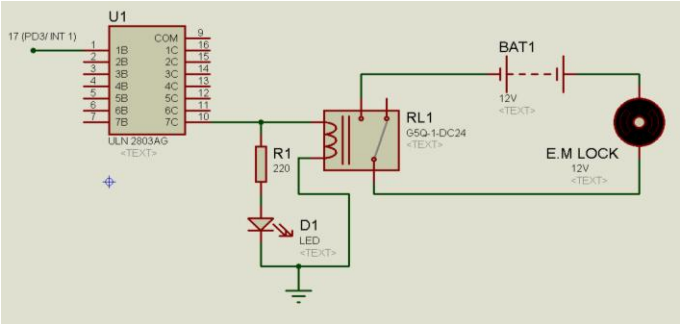

Figure 3.12 Circuit Diagram Relay Driver ULN2803AG

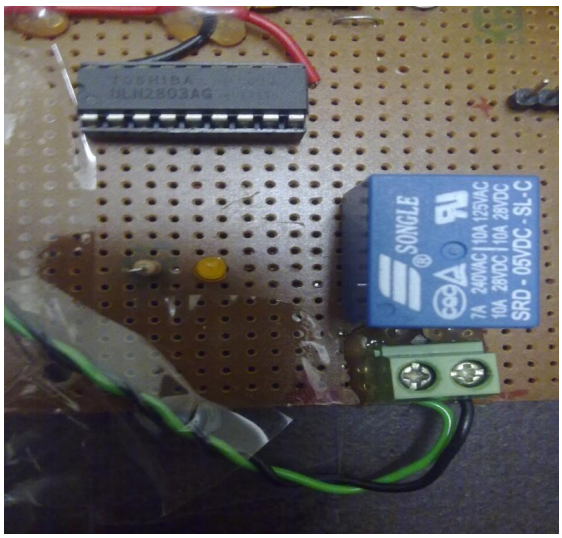

Figure 3.13 Relay Driver ULN2803AG

Figure 3.14 Electromagnetic Lock

3.2 Software Development

The circuit for these system cannot be operated if the system not be included with a program into microcontroller circuit. The planning program software design should be related to the flowchart of this system concepts. To create a program, user must be used the bases software AVR Studio. To enter the program into the microcontroller, users must used the software AVR Studio. Roughly the program that has created have a three system which is the system contains initializing, security and GSM system.

3.2.1 Initializing System

Initializing system is a main concept planning to launch a whole system. When a power supplied in this systems, first the system will initialize the LED. The next process is perform to checking a door. Limit switch is used to check a whether the door is open or closed. If the limit swith is closed, the electromagnetic lock ON and vice versa. There are four LEDs are used to initialize this system. If all the LED's ON that mean there is an error to the system, such as a lack of network coverage at GSM modem to proceed an operations. If the GSM modem is ready to begin the process conditions, the LED 1 will ON. The program of initializing systems design can be found in **Appendix A**.

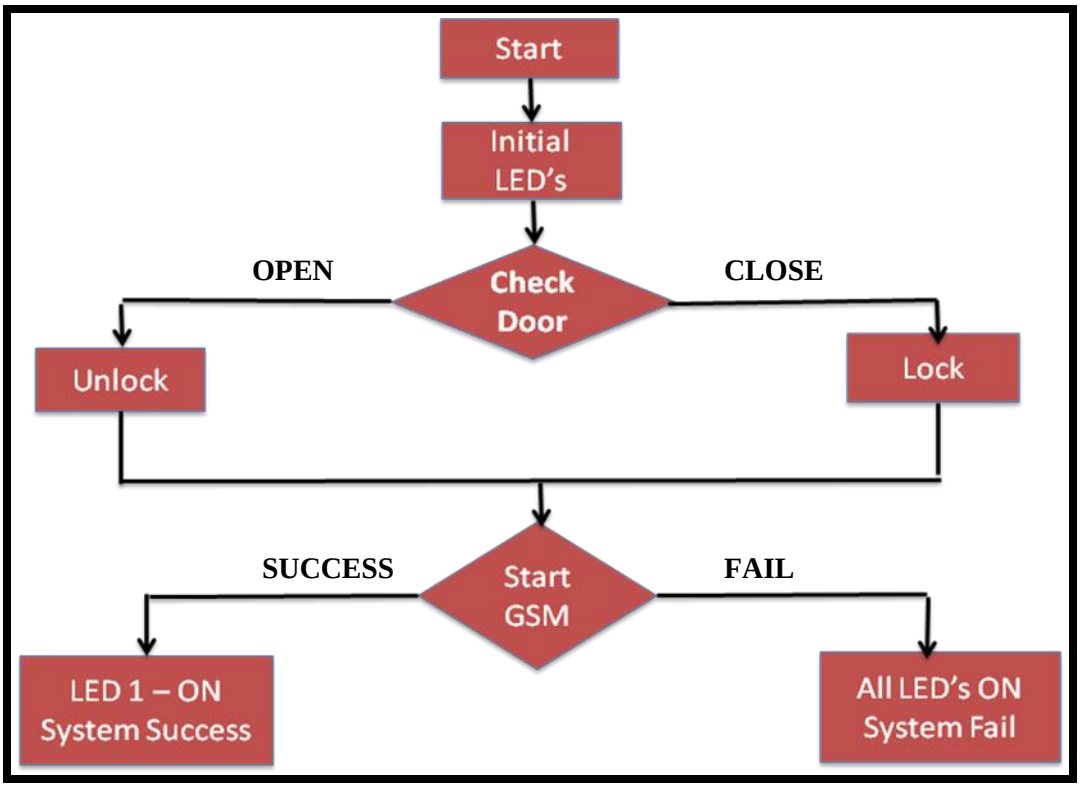

Figure 3.15 Flow Chart for Initializing System

3.2.2 Security System

To make the system safer and more effective, security system included in the program. Roughly, the overall systems was controlled by the one user which is admin user. To used the system, user (any number of SIM-card) should be registered into the microcontroller program. Maximum user is 65 number. There are some security situations were taken like a warning alert in case invasion criminal happened and send a wrong command or password. Users will received a warning for any errors made on this systems. Program system security can be found in **Appendix B**.

```
#include "app.h"
 #define MAX_USER 5

 uint8_t  admin[12]         ="+60147748841";
 uint8_t* notify = admin;
uint8_t USER_ID = 0;
 uint8_t cmdStat[6]         ="STATUS";
 uint8_t cmdRst[5]          ="RESET";
 uint8_t cmdLock[4]         ="LOCK";   //LOCK 4-digit-password
 uint8_t cmdUnlock[6]="UNLOCK";  //UNLOCK 4-digit-password

uint8_tuser[MAX_USER][12]={"+60137879814","+60147748841","xxxxxxxxxxx","xxxxxxxxxxx","};
 uint8_t pass[MAX_USER][4] ={"1234","5757","xxxx","xxxx",};
uint8_t secAlert[22]        = "ALERT-ALARM TRIGGERED!";
 uint8_t secRstErr[22]      = "ERROR-RESET THE SYSTEM";
 uint8_t secAdmin[20]       = "DENIED-CONTACT ADMIN";
 uint8_t secUnregUser[24]= "DENIED-UNREGISTERED USER";
 uint8_t secWrongPass[21]= "DENIED-WRONG PASSWORD";
 uint8_t secUnknown[22]= "DENIED-UNKNOWN COMMAND";
 uint8_t secLockPend[16]= "QUEUED-DOOR OPEN";

 uint8_t msg1[]="ALARM=TRIGGERED\r\nDOOR=OPEN\r\nLOCK=ON";
 uint8_t msg2[]="ALARM=TRIGGERED\r\nDOOR=OPEN\r\nLOCK=OFF";
 uint8_t msg3[]="ALARM=TRIGGERED\r\nDOOR=CLOSE\r\nLOCK=ON";
 uint8_t msg4[]="ALARM=TRIGGERED\r\nDOOR=CLOSE\r\nLOCK=OFF";
 uint8_t msg5[]="ALARM=IDLE\r\nDOOR=OPEN\r\nLOCK=ON";
 uint8_t msg6[]="ALARM=IDLE\r\nDOOR=OPEN\r\nLOCK=OFF";
 uint8_t msg7[]="ALARM=IDLE\r\nDOOR=CLOSE\r\nLOCK=ON";
 uint8_t msg8[]="ALARM=IDLE\r\nDOOR=CLOSE\r\nLOCK=OFF";
```

Figure 3.16 Programming with command SMS

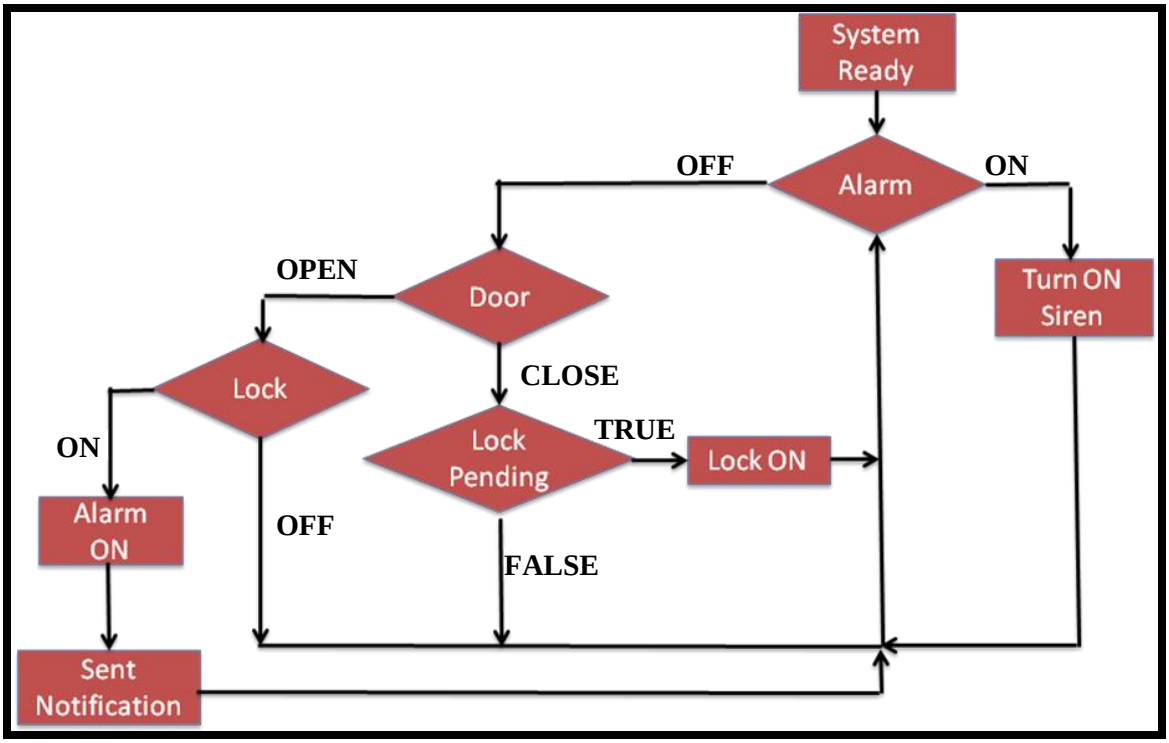

Figure 3.17 Flow Chart for Security System

3.2.3 GSM System

GSM system were included in this system is to ensure that systems runs smoothly. GSM system check every SMS send to GSM modem and ensure that the GSM transmit status or warning to the users with a more consistent and appropriate in the circumstances. Program for GSM system can be found in **Appendix C.**

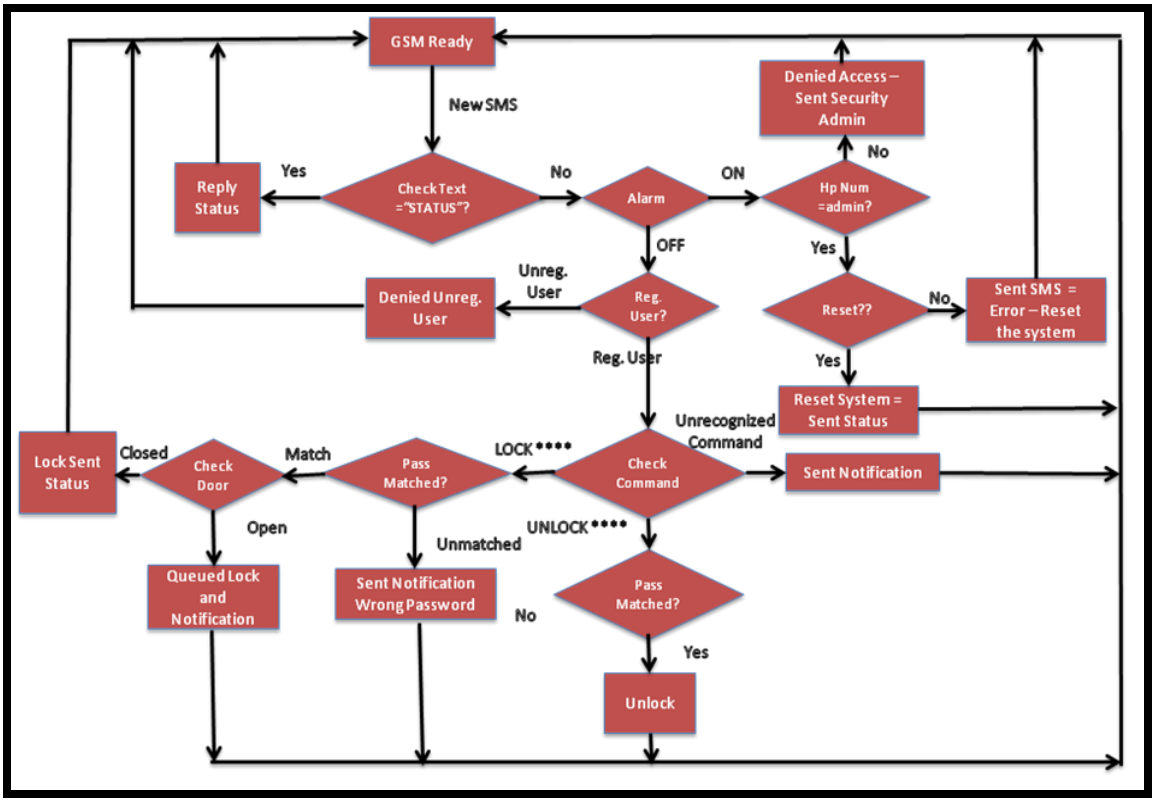

Figure 3.18 Flow Chart for GSM System

CHAPTER 4

RESULT & DISCUSSION

Form the study carried out by the hardware and software systems, this system can be controlled. From the operation of this system, there are several different applications. these applications include a general application system and the security system. More information further is described in the next section.

4.1 General Application System.

For the general applications system is include ways consumers user this system. These applications was included how to open and lock the door, reset the system and also check a status of the door for the moment using SMS. For the more information further is described below.

4.1.1 Reset System

The application reset system is to be used when to start and stop the alarm security. There is one user as an admin user to sent this command. Admin will sent an SMS command with typing “RESET” and sent to the GSM modem. Once the system already reset, at the same time user will receive an SMS from the GSM modem concern on the status of electromagnetic lock at that moment.

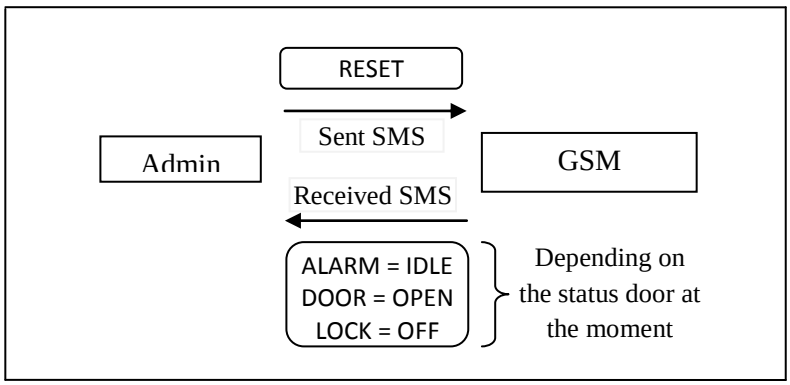

Figure 4.1 Block Diagram Application Reset System

4.1.2 Lock Door System

For the application to lock the door can only be done by the admin and registered users only. Users (admin & registered users) can send SMS command by typing “LOCK” and followed by a password that has been designated “XXXX” to the GSM modem. The door will automatically lock and the user will received SMS from GSM modem about the status of door and electromagnetic lock.

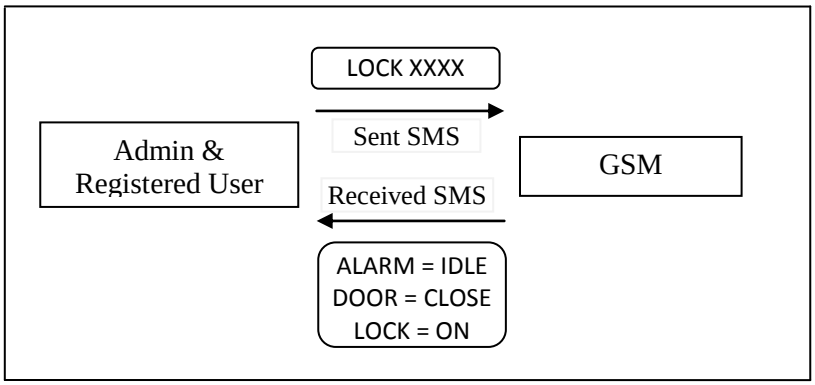

Figure 4.2 Block Diagram Application Lock Door System

4.1.3 Unlock Door System

The application for the locked doors can only be done by the admin and registered users only. Users can be send SMS command y typing “UNLOCK” followed by password that can be designated “XXXX” and send to the GSM modem. The door will open and this user will automatically received an SMS from GSM modem that concern about the status doors and electromagnetic lock for that moment.

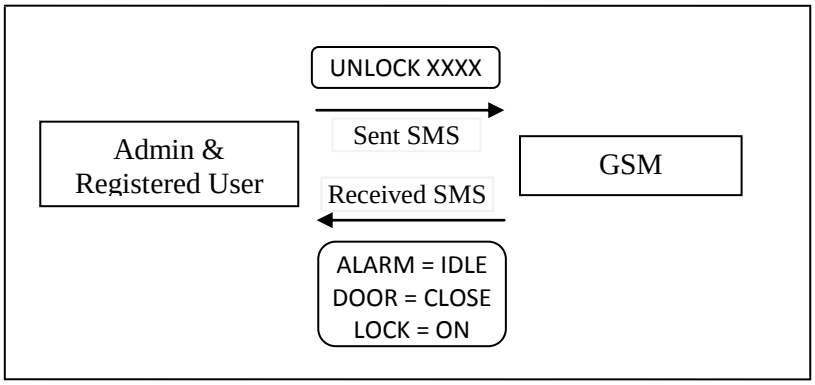

Figure 4.3 Block Diagram Application Unlock Door System

4.1.4 **Check Status Door**

The applications to check the status door and electromagnetic lock can be done by everyone. Users can send SMS command by typing “STATUS” to the GSM modem. each users will automatically received and SMS that concern about the status door and electromagnetic lock from GSM modem.

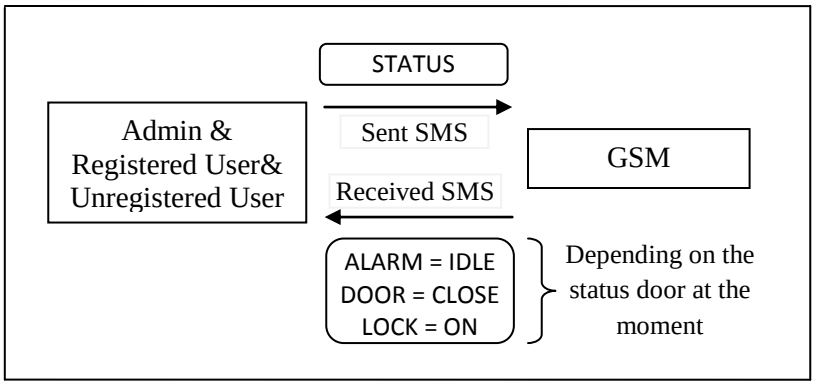

Figure 4.4 Block Diagram Application Check Status Door

4.2 **Application Security System**

To make this system more specific and effective, security system has be used in this system. These security system was include safety alert warning system comprising, users, password and the instruction.

4.2.1 Warning Alert

In the event of invasion criminal happen when the status door is closed and electromagnetic lock in the ON state, the door will open by the someone. Then the alarm will automatically ON and the admin user will received an SMS alerts “ALERT – ALARM TRIGGERED!” from the GSM modem.

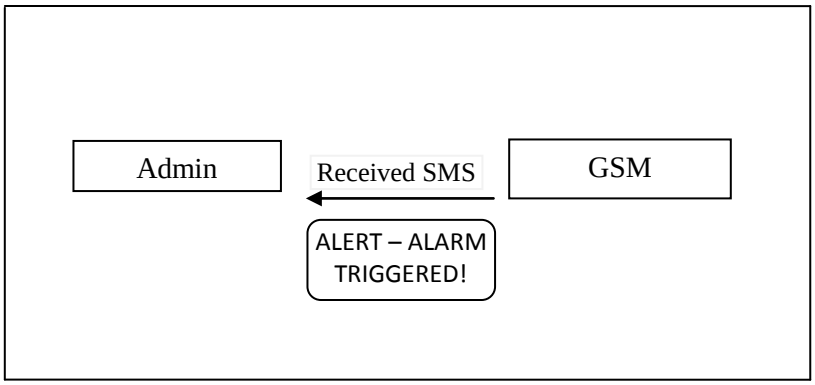

Figure 4.5 Block Diagram Security Warning Alert

4.2.2 Users

If the users does not sign and send through a command to lock or unlock the door system, the door cannot be opened or closed. At the same time, users will received an SMS alert “DENIED – UNREGISTERED USER” from the GSM modem.

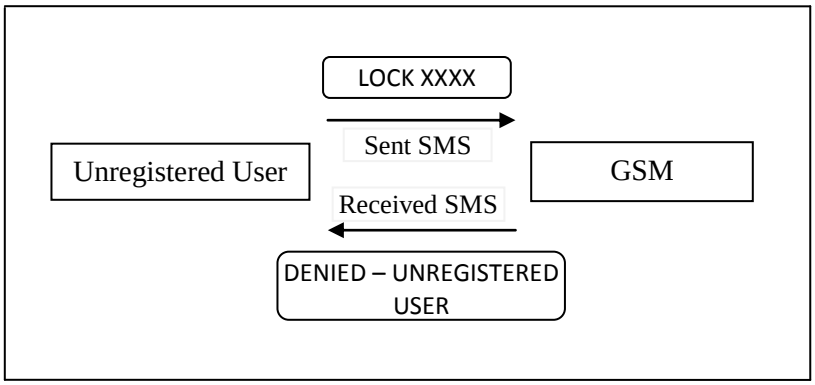

Figure 4.6 Block Diagram Security Users

4.2.3 Password

If the admin or registered users send a command to lock or unlock this system but followed with a wrong password, the door cannot be opened or closed. Users will received an SMS alert "DENIED – WRONG PASSWORD" from the GSM modem.

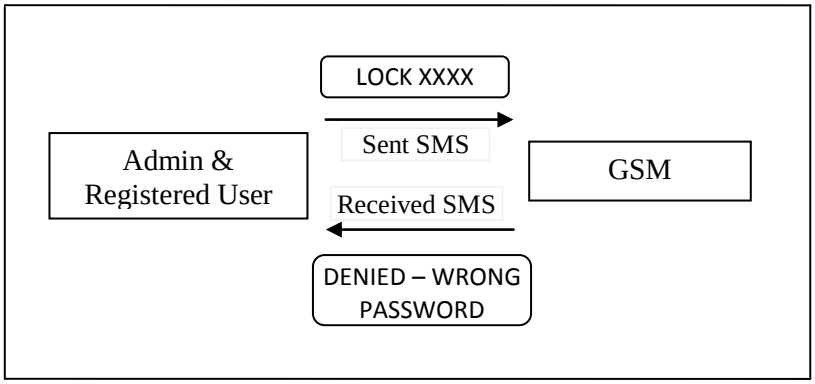

Figure 4.7 Block Diagram Security Password

4.2.4 Command

If the admin or registered users send the wrong command to reset, lock or unlock this system, the system will not reset and the door cannot be opened or closed. Users will automatically received an SMS alert “DENIED – UNKNOWN COMMAND” from the GSM modem.

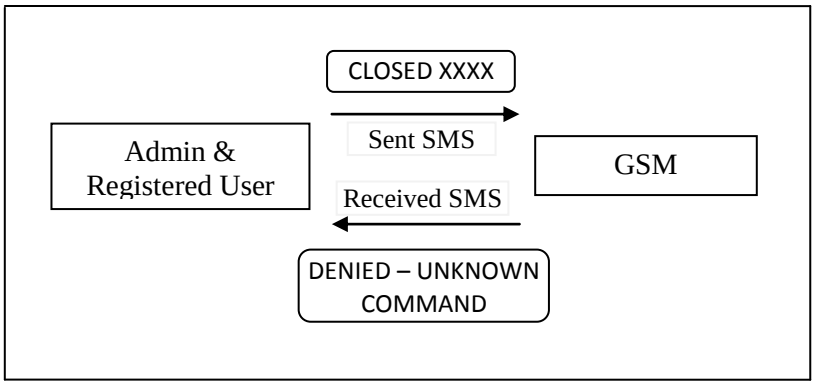

Figure 4.8 Block Diagram Security Command

CHAPTER 5

CONCLUSION & RECOMMENDATION

5.1 Conclusion.

This project was successful introduced base on the concepts that control door lock system via SMS. This concepts application base on the combination concepts product from the company Probyte and Witura Corporation. After the survey from the product of the both company already finish, the concepts of this system were able to create.

This system is using GSM modem as a main to received and transmitted a signal SMS through the SIM-card number of registered users. Once the registered user sent a SMS that contained command to unlock or lock door system, GSM will received a command and send to the signal through a microcontroller ATMega32. At this stage, microcontroller ATMega32 will conform that the command is matching with a program or not depending on the program code. ATMega32 will generate these command and

send to the relay driver to activated the relay control. Once the relay control active, the electromagnetic lock ON to closed the door and vice versa.

The security system also be included in this system. This system able to inform the admin users if any criminal invasion happened. This system also secure some building. In case if user send a wrong password or command, this system cannot be proceed to the next stage. Then this users immediately received a warning SMS from GSM modem. Command SMS that were send from users must be different to any situations to make system operated. For microcontroller ATMega32 is a powerful device in this system. This microcontroller ATMega32 were be able to save maximum registered number until 65 number for one time. So that mean as many as 65 users can uses this system. Seems like this system can be used in the meeting room, faculty class, office and etcetera. So for the overall conclusion of this project, to make the successful system of control automatic door lock via SMS, there is a lot of things to be consider such as these system able to protect that building or residence, able to easily used by user and be able to inform or responded through a users.. If one of them does not work then the system cannot follow the instructions set.

Figure 5.1 Product Control Door Lock System Via SMS

5.2 Project Problem

There are some problems in making the hardware architecture. The main problem encountered is the GSM antenna. GSM antenna is the last part on GSM modem to received and transmitted signal from outside. Green light LED will flash at the GSM modem with an interval 5 seconds means the GSM modem in standby-by to continue the process. Connection to antenna is often interrupted. So, should the cable end is punched a little further into the GSM antenna.

The second problem is about voltage regulator. The input supplied is 12V want to reduce the voltage until 5V for support a get logic circuit. For the first time using only two component voltage regulator which is 7809 and 7805. But after running this both component become heated. This problem can be settle after adding two component voltage regulator which is 7812, 7809, 7806 and 7805.

The third problems are the difficulties to burn the programming into the controller. This is because the problem of cable that interface the controller to pc. The cable is too sensitive and to burn the cable it is need to hold the cable until the burn process finished. The second problems that occurs during the same problems from the cable is the data that transmit and received during the burn process is not same, so the process need to try until the transmit signal be the same as received.

5.3 Recommendation and Suggestion of future Work

There are some recommendations and suggestions that can be apply in order to improve the automatic door lock system via SMS. Among method to improve this system is using door restrictor to automatically closed when someone open the door. For the example, in this case, if registered user sent an SMS to closed the door (ON electromagnetic lock) but moment that the door still open GSM will reply "QUEUED-DOOR OPEN". That mean the door must closed first to lock the electromagnetic lock. So, applied restrictor door in this system can ensure the door automatically closed.

For the second suggestion is using back-up battery 12V. In case, when present in situation electrical shutdown, this system cannot operate because there are not have power supplied. The purpose install back-up battery in this system is to ensure this system operate in several hour when power supplied shutdown.

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APPENDIX A

Programming for "Initializing System"

```
#include "app.h"

int main(){
	SYSTEM_init();
	SYSTEM_run();
	return 0;
}
void SYSTEM_init(void){
	LEDS_init();
	SEC_init();
	GSM_init();
}
void SYSTEM_run(void){
	while(1){
		SEC_check();
	}
}
void GSM_initDone(error_t isErr){
	if(isErr!=SUCCESS){
		LEDS_set(ALL_ON);
	}
	else{
		LEDS_on(1);
	}
}
```

APPENDIX B

Programming for “Security System”

```
#include "app.h"
 #define MAX_USER 5

 uint8_t  admin[12]              ="+60147748841";
 uint8_t* notify = admin;
uint8_t USER_ID = 0;
 uint8_t cmdStat[6]     ="STATUS";
 uint8_t cmdRst[5]      ="RESET";
 uint8_t cmdLock[4]   ="LOCK";      //LOCK 4-digit-password
 uint8_t cmdUnlock[6]="UNLOCK";//UNLOCK 4-digit-password

uint8_tuser[MAX_USER][12]={"+60137879814","+60147748841","xxxxxxxxxxxx”,"x
xxxxxxxxxxx","xxxxxxxxxxxx"};
 uint8_t pass[MAX_USER][4] ={"1234","5757","xxxx","xxxx","xxxx",};
uint8_t secAlert[22]             = "ALERT-ALARM TRIGGERED!";
 uint8_t secRstErr[22]           = "ERROR-RESET THE SYSTEM";
 uint8_t secAdmin[20]            = "DENIED-CONTACT ADMIN";
 uint8_t secUnregUser[24]        = "DENIED-UNREGISTERED USER";
 uint8_t secWrongPass[21]        = "DENIED-WRONG PASSWORD";
 uint8_t secUnknown[22]          = "DENIED-UNKNOWN COMMAND";
 uint8_t secLockPend[16]         = "QUEUED-DOOR OPEN";

 uint8_t msg1[]="ALARM=TRIGGERED\r\nDOOR=OPEN\r\nLOCK=ON";
 uint8_t msg2[]="ALARM=TRIGGERED\r\nDOOR=OPEN\r\nLOCK=OFF";
 uint8_t msg3[]="ALARM=TRIGGERED\r\nDOOR=CLOSE\r\nLOCK=ON";
 uint8_t msg4[]="ALARM=TRIGGERED\r\nDOOR=CLOSE\r\nLOCK=OFF";
```

```
 uint8_t msg5[]="ALARM=IDLE\r\nDOOR=OPEN\r\nLOCK=ON";
 uint8_t msg6[]="ALARM=IDLE\r\nDOOR=OPEN\r\nLOCK=OFF";
 uint8_t msg7[]="ALARM=IDLE\r\nDOOR=CLOSE\r\nLOCK=ON";
 uint8_t msg8[]="ALARM=IDLE\r\nDOOR=CLOSE\r\nLOCK=OFF";
/ *
 BOOL ALARM = FALSE;
 BOOL LOCK_ON    = FALSE;
 BOOL LOCK_PENDING = FALSE;
 BOOL DOOR_OPEN = FALSE;
/*

void sec_lock(void);
void sec_unlock(void);
void sec_updateStatus(uint8_t* hpNum);
void sec_adminRight(sms_t* sms);
void sec_userRight(sms_t* sms);

BOOL isDoorOpen(void);


void SEC_init(void){

        SET_BIT(DDRD,DDD3);     //set PD3 as output (relay control)

        SET_BIT(PORTC,PC0);     //set pull up for limit switch (NC)

        if(isDoorOpen()){               //check the door
                sec_unlock();           //initialize the door lock state - unlock/door open
        CLR_BIT(DDRC,DDC0);     //set PC0 as input (limit switch)pen
        }
        else{
                sec_lock();             //initialize the door lock state - lock/door close
        }
}

void SEC_check(void){

        isDoorOpen();

        if(!ALARM){
                if(DOOR_OPEN && LOCK_ON){
                        ALARM = TRUE;
                        GSM_tx(admin,secAlert,sizeof(secAlert));
                }
                else if(!DOOR_OPEN && LOCK_PENDING){
                        sec_lock();
                        //Update Sender
```

```
                        sec_updateStatus(notify);
                }
        }
        else{
                LEDS_toggle(4);
                _delay_ms(300);
        }
}

BOOL isDoorOpen(void){
        DOOR_OPEN = READ_BIT(PINC,PC0);
        return DOOR_OPEN;
}

void sec_lock(void){
        LOCK_PENDING = FALSE;

        SET_BIT(PORTD,PD3);
        LOCK_ON = TRUE;
}

void sec_unlock(void){
        CLR_BIT(PORTD,PD3);
        LOCK_ON = FALSE;
}

/*
 *
 */
void GSM_txDone(error_t err){
        if(err!=SUCCESS){
                LEDS_toggle(1);
                LEDS_toggle(2);
        }
        else{
                LEDS_toggle(2);
        }
}

void GSM_rx(sms_t* sms){

        LEDS_toggle(3);

        if(txtComp(sms->txt,cmdStat,6)){
                sec_updateStatus(sms->senderNum);
                return;
        }
```

```
        if(ALARM){
                sec_adminRight(sms);
        }
        else{
                sec_userRight(sms);
        }
}
void sec_updateStatus(uint8_t* hpNum){
        //ALARM = TRIGGERED
        if(ALARM){
                //DOOR = OPEN
                if(DOOR_OPEN){
                        //LOCK_ON = TRUE
                        if(LOCK_ON){
                                GSM_tx(hpNum,msg1,sizeof(msg1)-1);
                        }
                        //LOCK_ON = FALSE
                        else{
                                GSM_tx(hpNum,msg2,sizeof(msg2)-1);
                        }
                }
                //DOOR = CLOSE
                else{
                        //LOCK_ON = TRUE
                        if(LOCK_ON){
                                GSM_tx(hpNum,msg3,sizeof(msg3)-1);
                        }
                        //LOCK_ON = FALSE
                        else{
                                GSM_tx(hpNum,msg4,sizeof(msg4)-1);
                        }
                }
        }
        //ALARM = IDLE
        else{
                //DOOR = OPEN
                if(DOOR_OPEN){
                        //LOCK_ON = TRUE
                        if(LOCK_ON){
                                GSM_tx(hpNum,msg5,sizeof(msg5)-1);
                        }
                        //LOCK_ON = FALSE
                        else{
                                GSM_tx(hpNum,msg6,sizeof(msg6)-1);
                        }
                }
```

```
                //DOOR = CLOSE
                else{
                        //LOCK_ON = TRUE
                        if(LOCK_ON){
                                GSM_tx(hpNum,msg7,sizeof(msg7)-1);
                        }
                        //LOCK_ON = FALSE
                        else{
                                GSM_tx(hpNum,msg8,sizeof(msg8)-1);
                        }
                }
        }
}
void sec_adminRight(sms_t* sms){
        if(txtComp(!sms->senderNum,admin,12)){
                GSM_tx(sms->senderNum,secAdmin,sizeof(secAdmin));
                return;
        }

        if(txtComp(sms->txt,cmdRst,5)){
                ALARM = FALSE;
                LEDS_off(4);

                if(isDoorOpen()){
                        sec_unlock();
                }
                else{
                        sec_lock();
                }
        }
        else{
                GSM_tx(sms->senderNum,secRstErr,sizeof(secRstErr));
                return;
        }
        sec_updateStatus(sms->senderNum);
}

void sec_userRight(sms_t* sms){

                BOOL USER_EXIST = FALSE;

                for(uint8_t userID=0;userID<MAX_USER;userID++){
                        if(txtComp(sms->senderNum,&user[userID][0],12)){
                                USER_EXIST = TRUE;
                                USER_ID = userID;
                                break;
                        }
```

```
}
if(!USER_EXIST){
        GSM_tx(sms >senderNum,secUnregUser,sizeof(secUnregUser));
        return;
}

if(txtComp(sms->txt,cmdLock,4)){
                //      LOCK XXXX
                //      012345678
                        uint8_t pswrd[4]="xxxx";
                        uint8_t count = 0;

                        for(uint8_t cnt=5; cnt<9; cnt++){
                                pswrd[count++]=sms->txt[cnt];
                        }
if(txtComp(pswrd,&pass[USER_ID][0],4)){
                                if(isDoorOpen()){
                                        LOCK_PENDING = TRUE;
                                        notify = sms->senderNum;

        GSM_tx(notify,secLockPend,sizeof(secLockPend));
                                        return;
                                }
                                sec_lock();
                                sec_updateStatus(sms->senderNum);

                        }
                        else{
                                GSM_tx(sms
>senderNum,secWrongPass,sizeof(secWrongPass));
                                return;
                        }
                }
                else if(txtComp(sms->txt,cmdUnlock,6)){
                //      UNLOCK XXXX
                //      012345678910
                        uint8_t pswrd[4]="xxxx";
                        uint8_t count = 0;

                        for(uint8_t cnt=7; cnt<11; cnt++){
                                pswrd[count++]=sms->txt[cnt];
                        }

                        if(txtComp(pswrd,&pass[USER_ID][0],4)){
                                sec_unlock();
                                sec_updateStatus(sms->senderNum);
                        }
```

```
                    else{
                        GSM_tx(sms
>senderNum,secWrongPass,sizeof(secWrongPass));
                        return;
                    }
                }
                else{
                    GSM_tx(sms-
>senderNum,secUnknown,sizeof(secUnknown));
                }
}
```

APPENDIX C

Programming for "GSM System"

```
#include "app.h"

uint8_t* tmpTxt;
uint8_t  tmpTxtLen = 0;

/*****************************************************************************
 * ENUMERATIONS
 *****************************************************************************/
enum{
        GSM_INIT = 0x21,

        GSM_RX,
        GSM_TX,

        TX_CURSOR,
        TX_COUNTER,
        TX_ACK,

        RX_AVAIL,
        RX_READ,

        TXT_STATUS,
        TXT_SENDER,
        TXT_TOD,
        TXT_TXT,
        TXT_ACK,
```

```
        SMS_DEL,
};
uint8_t GSM_STATE;
uint8_t TX_STATE;
uint8_t RX_STATE;
uint8_t RX_TXT;
/*****************************************************************************
 * STRING LIST
 *****************************************************************************/
uint8_t okTxt[2] = "OK";
uint8_t cmti[5]="+CMTI";
uint8_t txtStat[10]="REC UNREAD";
/*****************************************************************************
 * AT COMMAND LIST
 *****************************************************************************/
uint8_t newSmsAlert[11]         ="AT+CNMI=1,1";
uint8_t setTxtFormat[9]         ="AT+CMGF=1";
uint8_t sendTxt[8]                      ="AT+CMGS=";
uint8_t readReq[8]                      ="AT+CMGR=";
uint8_t atDelSMS[8]                     ="AT+CMGD=";

uint8_t crlf[2]={0x0D,0x0A};
/*****************************************************************************/
/*****************************************************************************
 * PRIVATE VARIABLES
 *****************************************************************************/
uint8_t rxAtAck[3];

uint8_t atTxCount[20];
uint8_t atRxInd[20];

uint8_t txtStatus[10];

uint8_t rxCount = 0;

BOOL MARKER = FALSE;
BOOL STARTED = FALSE;
/*****************************************************************************
 * PRIVATE FUNCTIONS PROTOTYPE
 *****************************************************************************/
void gsm_sendAt(uint8_t* atCmd,uint8_t len);
void gsm_rxAtAck(uint8_t data);
void gsm_atResponse(error_t err);
void gsm_txTxt();
void gsm_rxTxCounter(uint8_t data);
void gsm_rxTxInd(uint8_t data);
void gsm_rxTxt(uint8_t data);
```

```
void gsm_txtDel(uint8_t index);
/*****************************************************************************/
/*****************************************************************************
 * APPLICATION PROGRAMMING INTERFACE
 *****************************************************************************/
void GSM_init(void){

	GSM_STATE = GSM_INIT;

	TX_STATE = TX_CURSOR;
	RX_STATE = RX_AVAIL;
	RX_TXT  = TXT_STATUS;

	USART_init();
	ENABLE_INTERRUPTS();

	gsm_sendAt(newSmsAlert,sizeof(newSmsAlert));
}

void GSM_tx(uint8_t* hp,uint8_t* sms,uint8_t len){
	_delay_ms(2500);
	GSM_STATE = GSM_TX;
	TX_STATE = TX_CURSOR;

	tmpTxt = sms;
	tmpTxtLen = len;

	USART_txStream(sendTxt,sizeof(sendTxt));
	USART_txByte('\"');
	USART_txStream(hp,12);
	USART_txByte('\"');
	USART_txStream(crlf,2);
}
void USART_rx(uint8_t data){
	switch(GSM_STATE){
		case GSM_INIT:
			gsm_rxAtAck(data);
			break;
		case GSM_TX:
			switch(TX_STATE){
				case TX_CURSOR:
					if(data=='>'){
						TX_STATE = TX_COUNTER;
						gsm_txTxt();
					}
					break;
				case TX_COUNTER:
					gsm_rxTxCounter(data);
```

```
                                        break;
                                case TX_ACK:
                                        gsm_rxAtAck(data);
                                        break;
                        }
                        break;
                case GSM_RX:
                        switch(RX_STATE){
                                case RX_AVAIL:
                                        gsm_rxTxInd(data);
                                        break;
                                case RX_READ:
                                        gsm_rxTxt(data);
                                        break;
                        }
                        break;
                case SMS_DEL:
                        gsm_rxAtAck(data);
                        break;
        }
}
/*****************************************************************************/

/*****************************************************************************
 * PRIVATE FUNCTIONS PROTOTYPE
 *****************************************************************************/
void gsm_sendAt(uint8_t* atCmd,uint8_t len){
        USART_txStream(atCmd,len);
        USART_txStream(crlf,2);
}

void gsm_txTxt(void){
        USART_txStream(tmpTxt,tmpTxtLen);
        USART_txByte(0x1A);
}

void gsm_txRdReq(void){
        RX_STATE = RX_READ;
        USART_txStream(readReq,sizeof(readReq));
        USART_txByte(newSMS.index);
        USART_txStream(crlf,2);
}
/*****************************************************************************/
void gsm_rxAtAck(uint8_t data){
        if(data==0x0A && !MARKER){
                MARKER = TRUE;
                rxCount = 0;
        }
```

```
        else if(data==0x0A && MARKER){
                MARKER = FALSE;
                if(txtComp(rxAtAck,okTxt,2)){
                        gsm_atResponse(SUCCESS);
                }
                else{
                        gsm_atResponse(FAIL);
                }
                rxCount = 0;
        }
        else if(MARKER){
                rxAtAck[rxCount++] = data;
        }
}
void gsm_atResponse(error_t isErr){
        switch(GSM_STATE){
                case GSM_INIT:
                        if(isErr!=SUCCESS){
                                GSM_initDone(FAIL);
                                return;
                        }
                        if(!STARTED){
                                STARTED = TRUE;
                                gsm_sendAt(setTxtFormat,sizeof(setTxtFormat));
                        }
                        else{
                                STARTED = FALSE;
                                GSM_STATE = GSM_RX;
                                GSM_initDone(SUCCESS);
                        }
                        break;
                case GSM_TX:
                        GSM_STATE = GSM_RX;
                        TX_STATE = TX_CURSOR;
                        RX_STATE = RX_AVAIL;

                        GSM_txDone(isErr);
                        break;
                case SMS_DEL:
                        if(isErr!=SUCCESS){
                                GSM_STATE = GSM_RX;
                                return;
                        }
                        if(txtComp(txtStatus,txtStat,10)){
                                newSMS.status = UNREAD;
                        }
                        else{
                                newSMS.status = READ;
```

```
                        }
                        GSM_STATE = GSM_RX;
                        GSM_rx(&newSMS);
                        break;
        }
}
void gsm_rxTxCounter(uint8_t data){
        if(data==0x0A && !MARKER){
                MARKER = TRUE;
                rxCount = 0;
        }
        else if(data==0x0A && MARKER){
                MARKER = FALSE;
                TX_STATE = TX_ACK;
                rxCount = 0;
        }
        else if(MARKER){
                atTxCount[rxCount++] = data;
        }
}

void gsm_rxTxInd(uint8_t data){
        if(data==0x0A && !MARKER){
                MARKER = TRUE;
                rxCount = 0;
        }
        else if(data==0x0A && MARKER){
                MARKER = FALSE;
                if(!txtComp(atRxInd,cmti,5)){
                        TX_STATE = TX_CURSOR;
                        GSM_STATE = GSM_RX;
                        RX_STATE = RX_AVAIL;
                        GSM_txDone(FAIL);
                        return;
                }
                if(atRxInd[12]>'9'){
                        TX_STATE = TX_CURSOR;
                        GSM_STATE = GSM_RX;
                        RX_STATE = RX_AVAIL;
                        GSM_txDone(FAIL);
                }
                newSMS.index = atRxInd[12];
                gsm_txRdReq();
                rxCount = 0;
        }
        else if(MARKER){
                atRxInd[rxCount++] = data;
        }
```

```
}
void gsm_rxTxt(uint8_t data){
	switch(RX_TXT){
		case TXT_STATUS:
			if(data==0x22 && !MARKER){
				MARKER = TRUE;
				rxCount = 0;
			}
			else if(data==0x22 && MARKER){
				MARKER = FALSE;
				rxCount = 0;
				RX_TXT = TXT_SENDER;
			}
			else if(MARKER){
				txtStatus[rxCount++] = data;
			}
			break;
		case TXT_SENDER:
			if(data==0x22 && !MARKER){
				MARKER = TRUE;
				rxCount = 0;
			}
			else if(data==0x22 && MARKER){
				MARKER = FALSE;
				rxCount = 0;
				//done
				RX_TXT = TXT_TOD;
			}
			else if(MARKER){
				newSMS.senderNum[rxCount++] = data;
			}
			break;
		case TXT_TOD:
			if(data==0x22 && !MARKER){
				MARKER = TRUE;
				rxCount = 0;
			}
			else if(data==0x22 && MARKER){
				MARKER = FALSE;
				rxCount = 0;
				//done
				RX_TXT = TXT_TXT;
			}
			else if(MARKER){
				newSMS.tod[rxCount++] = data;
			}
			break;
		case TXT_TXT:
```

```
                        if(data==0x0A && !MARKER){
                                MARKER = TRUE;
                                rxCount = 0;
                        }
                        else if(data==0x0A && MARKER){
                                MARKER = FALSE;
                                newSMS.smsLen = rxCount;
                                rxCount = 0;
                                //done
                                RX_TXT = TXT_ACK;
                        }
                        else if(MARKER){
                                newSMS.txt[rxCount++] = data;
                        }
                        break;
                case TXT_ACK:
                        if(data==0x0A && !MARKER){
                                MARKER = TRUE;
                                rxCount = 0;
                        }
                        else if(data==0x0A && MARKER){
                                MARKER = FALSE;
                                rxCount = 0;
                                if(txtComp(rxAtAck,okTxt,2)){
                                        RX_TXT = TXT_STATUS;
                                        RX_STATE = RX_AVAIL;
                                        gsm_txtDel(newSMS.index);
                                        break;
                                }
                                else{
                                        RX_TXT = TXT_STATUS;
                                        RX_STATE = RX_AVAIL;
                                }
                        }
                        else if(MARKER){
                                rxAtAck[rxCount++] = data;
                        }
                        break;
        }
}
void gsm_txtDel(uint8_t index){
        GSM_STATE = SMS_DEL;

        USART_txStream(atDelSMS,sizeof(atDelSMS));
        USART_txByte(index);
        USART_txStream(crlf,2);
}
/*****************************************************************************/
```

```
BOOL txtComp(uint8_t* txt1,uint8_t* txt2,uint8_t len){
	for(uint8_t i=0;i<len;i++ ){
		if(txt1[i]!=txt2[i]){
			return FALSE;
		}
	}
	return TRUE;
```